Endcap Muon Alignment System Development

- Development of Alignment Scheme
- Development of Alignment Sensors and Related Components
- Construction of Integrated Full Scale Mockup of System
- Simulation of Alignment Scheme and Effect on CMS Physics

Overview of Alignment Requirements

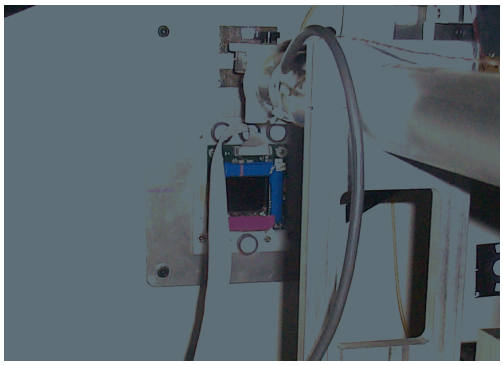
- **Understand Final Alignment Scheme Parameters**
  - **Mechanical Tolerances**
  - **Survey / Photogrametry**
  - **Alignment Monitoring**
- **Develop Alignment Monitoring Scheme for Endcap Chambers and ME Stations**
  - **Provide Phi Reference Plane and ME Station Positions**
  - **Relate Muon Stations Positions to Endcap Chamber (Z)**
  - **Provide Muon Endcap Chamber position tracking (R, Φ)**

Development of Transparent Sensors

DCOPS (Digital CCD Optical Position Sensors)

4 CCDs connected to an ADC and onboard DSP

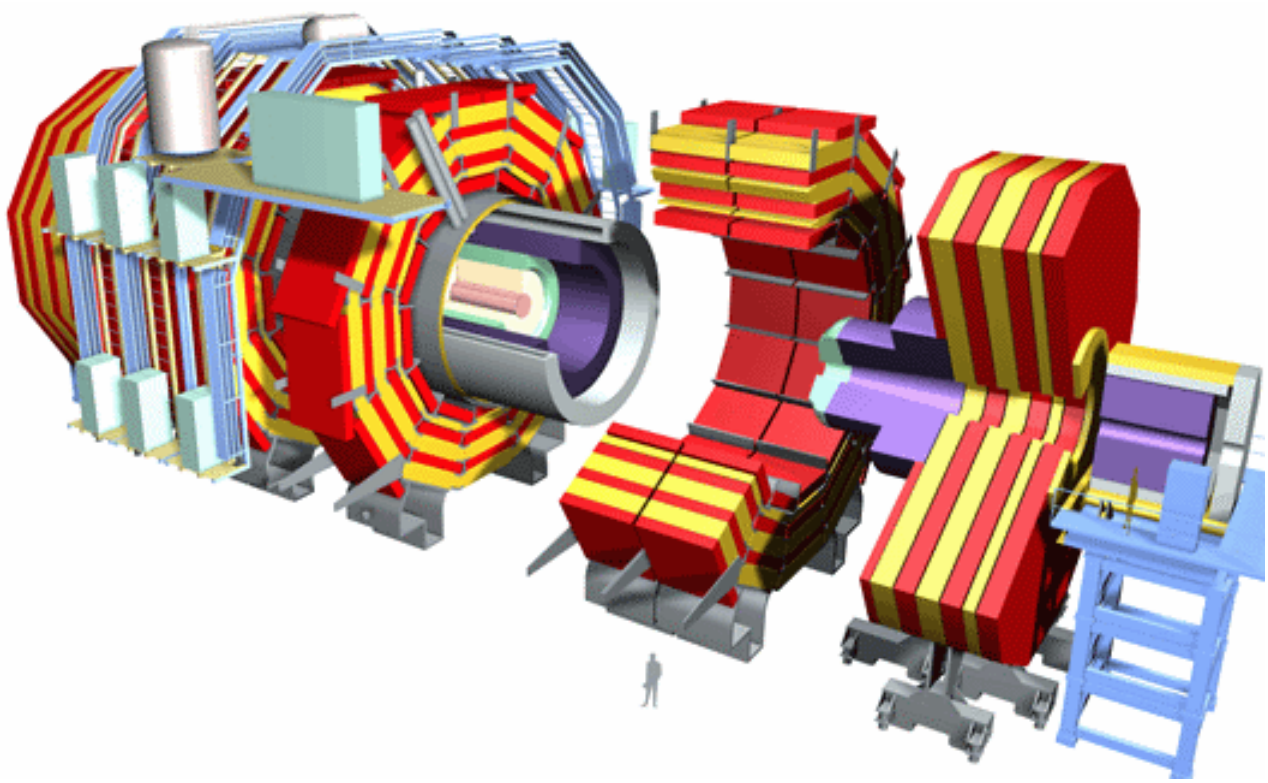
Individual DCOPS daisy chained to readout PC via serial connection.



Development of DCOPS at Fermilab

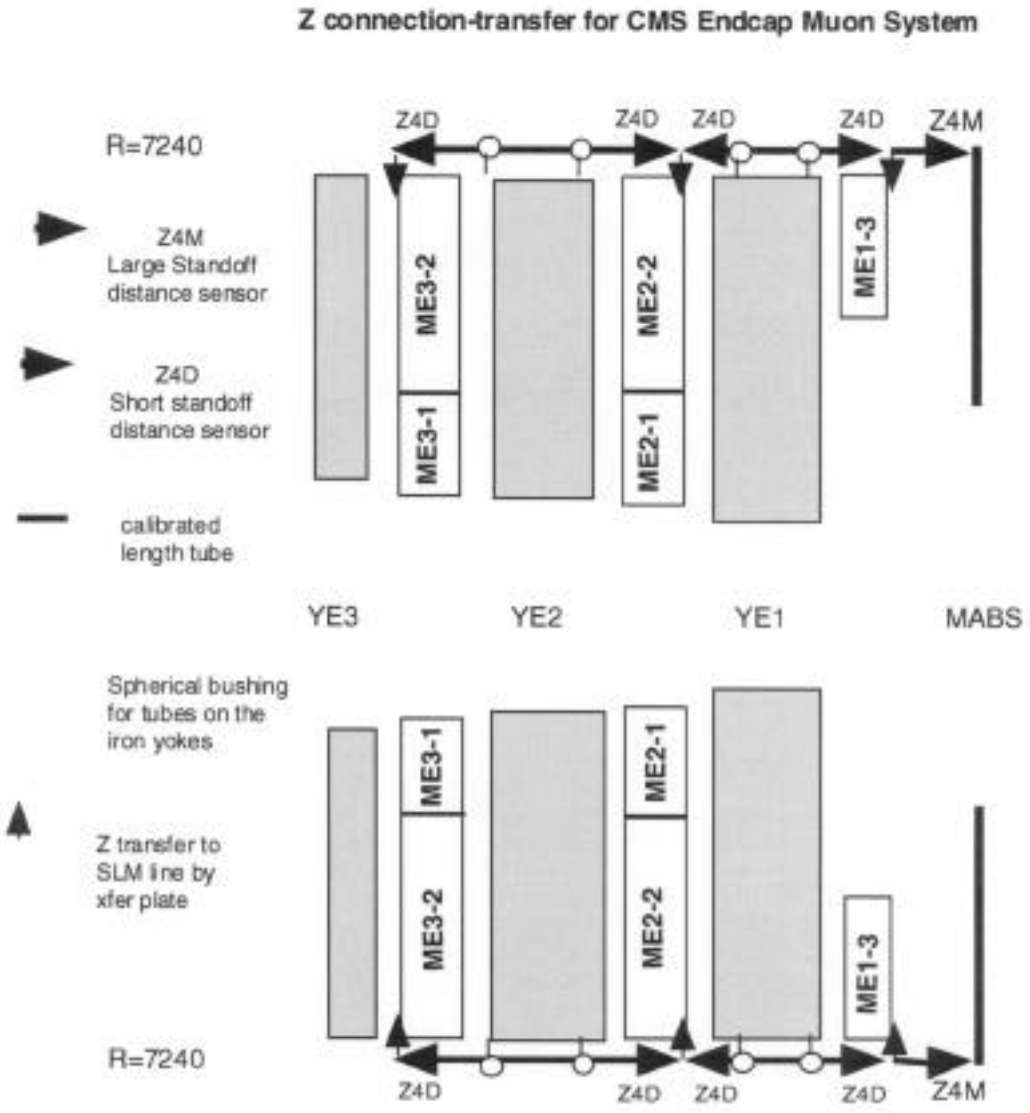
- **Participated in initial testing, debugging, and continued revision of firmware**
- **Developed readout software**
- **Evaluation of Sensor Performance**
- **Worked with Filter Scheme**
  - Ambient light saturates CCD
  - Laser must be attenuated for near sensors
- **Construction of 14m DCOPS test bench at FNAL with 10 DCOPS Sensors**

Axial Line Transfer Scheme



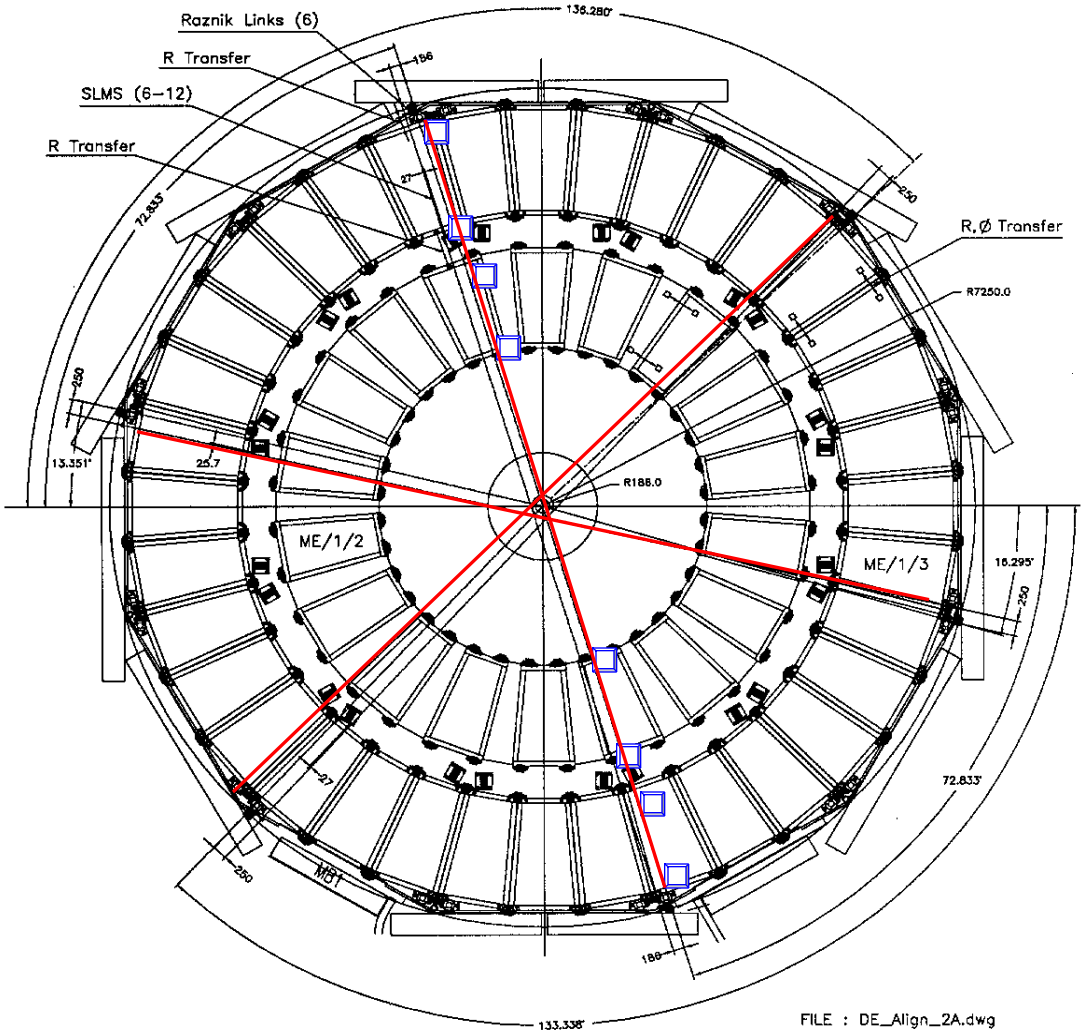
Axial Line Transfer Scheme (cont)

Distance in Z transferred from known points on MAB to ME layers by precision Analog Sensors and Carbon Fiber Reference bar.



Chamber SLM Alignment Scheme

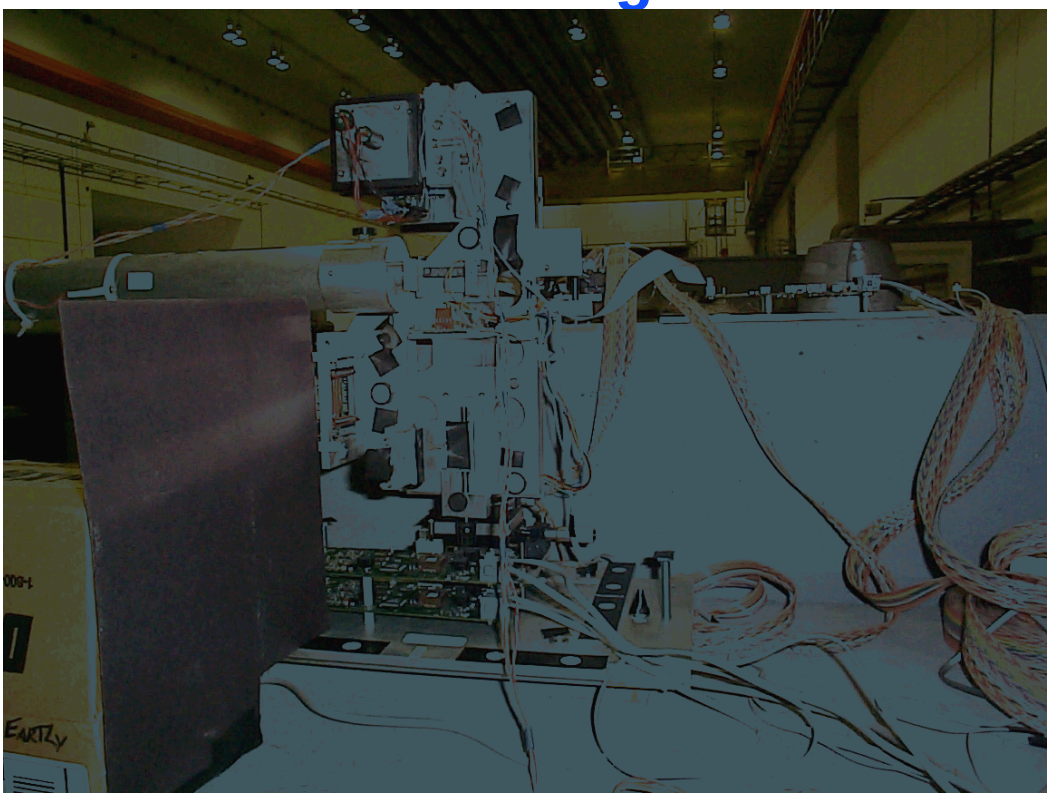
Concept : Attach transparent, photosensitive detectors on the chambers and monitor the relative motion wrt a fixed laser line (R, Φ).



Axial – SLM Line Interface

Transfer Plate

- Mechanically fixes DCOPS sensor on Axial Line to Laser on SLM line.
- Mount point for Z-Tube and Proximity sensors
- Includes XY Plane Tiltmeter and associated analog sensors



Full Scale EMU Alignment Test at CERN

Purpose

- Setup a complete hardware prototype of one Endcap Transfer line with a connection to SLM Line
- Demonstrate global readout and analysis of all system components
- Demonstrate EMU performance with Link and Barrel alignment systems

Preparation for Tests

- Integrated DAQ + Analysis
- Calibration of Analog devices
- Initial Photogrametry and CMM Measurements (for later reconstruction)

Test Schedule

- Setup and Initial System Tests (3 weeks, June 2000 – complete)
- Joint tests with LINK and Barrel Groups (July/Aug 200 – complete)
- Joint Tests with LINK and Barrel Groups (Sept 2000)

ISR Test Setup

Title:
isr_test_config.ps
Creator:
fig2dev Version 3.2.3 Patchlevel
Preview:
This EPS picture was not saved
with a preview included in it.
Comment:
This EPS picture will print to a
PostScript printer, but not to
other types of printers.

ISR Test Setup

View down SLM Line
from Transfer Plate(up)
View across Axial Line (L)

June 2000 Setup – Note Tripod fills in for MAB

Two views of Axial line
from transfer plate (up)
and from far end (L)

July / August 2000 Setup – Addition of MAB signifies integrated run with LINK and Barrel